UNIVERSITI PUTRA MALAYSIA

DECISIONS ON ADDITIONAL COUNTERS IN THE BANKING INDUSTRY AND APPLICATIONS OF THE QUEUING THEORY

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DECISIONS ON ADDITIONAL COUNTERS IN THE BANKING INDUSTRY AND APPLICATIONS OF THE QUEUING THEORY

By

SEOW HSIN VONN

Thesis Submitted in Partial Fulfilment of the Requirements for the
Degree of Master of Science in the
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December 2000

DEDICATION

This book is dedicated to my family especially my mum and my dad for their patience and faith in me.

"Hold on to your dreams as they are

the blueprints of your future ..."

To Floy, Kim and Janice, thanks for understanding. To Chen, Joe, Sau Lim and the rest of the Net Space Gang, thanks for being there !

Abstract of thesis submitted to the Senate of Universiti Putra Malaysia
in partial fulfilment of the requirements for the degree of Master of Science.

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December 2000

Chairman: **Salleh Yahya, Ph.D**

Faculty: **Malaysian Graduate School of Management**

Many researchers have long explored the effects of customer waiting time on service level. In Malaysia, however, the effects of this particular issue have seldom been explored. This study was conducted to reduce this gap by examining the relationship between the waiting time and customer satisfaction level in Malaysia's banking industry. The focus of the thesis is the determination of counters and the tradeoff between the opportunity cost and the service level offered by the bank.

First, data related to waiting lines was obtained from the QMS system of Bank XYZ. This data includes all costs data required in this study. Questionnaires were also distributed to customers of Bank XYZ to gather information in estimating

their opportunity cost. All the data was analysed using various procedures. As an example, the arrival and server pattern was analysed using the K-S test. The result indicates the arrival and server pattern to be Poisson distribution and Exponential distribution respectively.

Separate procedures were developed to find optimal number of counters using maximum allowable waiting time and cost model. The result indicates that this method of calculating optimal counters is possible and reliable. The overall result of this study can be repeated and can be easily utilised by other banking institutions in managing their queuing problem.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
Sebagai memenuhi sebahagian keperluan untuk ijazah Master Sains

KEPUTUSAN UNTUK MEMBUKA KAUNTER TAMBAHAN DALAM INDUSTRI PEMBANKAN DAN APLIKASI TEORI BERATUR

Oleh

SEOW HSIN VONN

Disember 2000

Pengerusi: **Salleh Yahya, Ph.D.**

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Sesungguhnya, kajian terhadap kesan menunggu untuk mendapatkan perkhidmatan telah lama dikajikan oleh ahli-ahli penyelidik pengurusan. Akan tetapi, hasil kajian ini tidak banyak mendapat perhatian di Malaysia. Kajian ini membantu mengisi kekosongan iaitu dengan menyelidiki kesan menunggu dengan tahap kepuasan pengguna di industri pembankan di Malaysia. Penumpuan diberi ke atas penentuan kaunter dan pemilihan antara kos lepas dan tahap perkhidmatan yang diberikan oleh bank. Sektor pembankan telah dipilih untuk kajian ini kerana di dalam sektor inilah kesan- kesan Teori Beratur dapat diperhatikan dengan jelas.

Data telah diperoleh dari Bank XYZ. Data tambahan yang diperlukan untuk pengiraan kos kaunter telah dihasilkan dari data tersebut. Tambahan pula, satu soal selidik telah diedarkan kepada pelanggan Bank XYZ untuk mendapat maklumat untuk pengiraan kos lepas pelanggan. Kadar ketibaan pelanggan dan masa untuk servis atau perkhidmatan telah diuji dan didapati mengikut taburan Poisson dan taburan Eksponen masing-masing.

Atur cara yang berlainan telah digunakan untuk menentukan bilangan kaunter yang optimal berdasarkan masa menunggu maksimum dan model kos yang dibangunkan. Kajian menunjukkan bahawa kedua-dua atur cara untuk menentukan bilangan kaunter optimal ini adalah mungkin dan meyakinkan. Atur cara yang digunakan dalam kajian ini dapat direplikasikan dan digunakan dengan mudah oleh bank-bank lain untuk menguruskan masalah beratur.

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Special thanks to those who were crucial in supporting and making my research progress and complete. Also, a big thank you to my employer for understanding and accommodating me during the period of my studies and research. To my teachers, thank you for the dream.

Last but not least, I like to thank you my family and friends for bearing with my behavior and commitment to my masters. A heart felt thank you to Kenny for his support, patience and help in completing my thesis. I couldn't have done it without you!

I certify that an Examination Committee met on 18 December, 2000 to conduct the final examination of Seow Hsin Vonn on her Master of Science thesis entitled "Decisions on Additional Counters in the Banking Industry and Applications of the Queuing Theory" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION FORM

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

SEOW HSIN VONN

Date: 18 December 2000

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LIST OF ABBREVIATIONS

BQM	:	Banking Queueing Model
df	:	Derivative Function
EDA	:	Exploratory Data Analysis
FCFS	:	First Come First Serve
KS	:	Kolmogorov- Smirnov
LCFS	:	Last Come First Serve
LST	:	Laplace-Stleltjes-Transform
OPAC	:	Online Public Access Catalogs
PASTA	:	Poisson Arrivals See Time Average
pdf	:	Probability Density Analysis
PERT	:	Program Evaluation Reviewing Technique
QMS	:	Queueing Management System
ROS	:	Random Order of Service
UPM	:	Universiti Putra Malaysia
VB	:	Visual Basic V.6.0

CHAPTER I

INTRODUCTION

Introduction

Researchers have long known the importance and usefulness of the applications of the queuing theory in every day life. That is why researchers like Wolff (1982) studied queuing problems in detail and established a meaningful relationship with actual practice in daily life. The queueing problems are influenced by elements such as:

(1) The arrival rate of customers or crew

(2) The operation time or time needed to service the customers

(3) The number of servers available

(4) The behaviour of the customers in the queue

Customers arrive for service at different times during the day and the arrival is believed to be random and spread over time. Therefore, the behavior of the customer's arrival pattern and the reaction of all the above elements will determine the extent of queueing in that system. To illustrate an example of this behaviour, Wolff (1982) conducted a study on the Poisson Arrivals See Time Average (PASTA) to study the behavior of the arrivals.

It is often assumed that in a queue, the arrival rate follows a Poisson distribution. However, not all arrival processes are of Poisson distribution. Albin (1984) studied the practicality of a single server model (M/M/1) to accurately predict the operating characteristics of queues with arrival processes that slightly differ from the Poisson process. Different kinds of arrival rates and different aspects of this element give room for study. For example, Cosmetatos and Godsave (1980) made approximations for the equilibrium queue-size and queueing-time in the multi-server queue with hyper-exponential inter-arrival times and exponential service time.

Service time is the fraction of time used by the server to complete the service for the customer. Work on service time include those of Pinedo and Wolff (1982) who illustrated the comparison between tandem queues with dependent and independent service times. In addition, service time adds to the waiting time of customers still in the queue.

Among all the elements of the queue, waiting time greatly influences the length of the queue. Waiting time is the time a customer waits in the queue before receiving the service. What can the customers do while waiting? How can management make the waiting time more agreeable? Waiting time deeply influences the behavior of customers in the queue as shown by Mowen and Mowen (1991). Some might choose not to queue up in view of the length of the queue (*balk*) and others after queueing up for a considerable time might choose to leave the queue after waiting time exceeds the expected waiting time as studied by Davis and Heineke (1

Customers who balk or renege are a loss to the bank. Customers come in with the intention to use the service. However, they do not use the service because of long queues and lengthy waiting time. They leave feeling dissatisfied. Customer satisfaction is very important. When a customer queues for a service, one of the main factors that contribute to the customers satisfaction is the waiting time. In a study done by Jones and Dent (1993), 70% of all service customers were clearly concerned about the waiting times.

The number of servers influences the length of a queue. More number of servers mean shorter queues and shorter waiting time. Shorter queues and waiting times bring satisfaction to the customers. The trick is to find a way to predict the optimal number of counters based on the arrival rates of the customers. Green (1980) studied a multiserver queuing system in which the customers would request service from a random number of identical servers. But, the customers are not able to receive service until all the required servers are available. Green (1980) derived the steady-state distribution of the waiting time and the distribution of busy servers among others. The implication of the application of such a model would be most beneficial.

Cost is another aspect that comes hand in hand with the study of any queuing system. The time spent in queues is actually cost to the customers . This is a very interesting aspect of the queuing phenomena and can be looked into for further study.

In many cases, it is the behaviour of the people in the queue that influences the queue. Many will be willing to wait for a certain amount of time. After this limit, impatience sets in. This results in the organization losing its customers.

The applications of the queuing theory is often taken for granted. Ships that come and dock at the shipyards utilize the queuing theory in minimizing cost in terms of docking fees. At the supermarket, when there are many customers waiting to pay for their groceries, more cashiers have to be operational so that the customers need not wait for a long time. Banks are institutions where the potential application of the queuing theory to shorten the waiting time of the customers could be further studied.

The bank is an important part of a person's life. Everybody needs to go to the bank. Almost every day, people queue up to deposit, to cash cheques or to withdraw their hard-earned money from these banks. More often than not, these hard-working people will have to queue up to wait for their turns to obtain the services offered by that particular bank.

The element of cost is important both to the bank as well as the customers. The average person will probably go to the bank during their lunch break or during office hours to attend to certain transactions. The extra time spent queuing up could be spent more productively like performing a task that in turn would lead to some reward such as wages or even a promotion. It all boils down to why should the customer should spend so much time waiting to be serviced by a bank and waste all that time when there are other banks that provide the same kind of service at a faster

rate. This is one of the reasons why banks often lose their customers. For the bank, additional cost in the form of wages is incurred when it assigns more servers than necessary for optimum service.

Customers who wait in a queue do suffer loses called opportunity cost. This cost is the cost they bear for staying in the queue too long. It might be the wages that they might be earning if they are at work or the profits of a business transaction. A study on multiserver costing was done by Johnson (1978) but it paid more attention to the costing of the airline than to the customers themselves. Customers need to be educated on the opportunity cost they incur while in a queue to show them how wasteful it is to spend long time waiting in line.

In Malaysia, this situation is no exception. A detailed study of the practical usage of the queuing theory will prove to be a major contribution to the banking industry in Malaysia. Queuing is an every day occurrence, affecting people shopping for groceries, buying gasoline or making a bank deposit. But unfortunately, it seems that its importance has been overlooked. Proper application of the queueing theory, will result in improvement in the service and in the levels of customer satisfaction .

Now, what would happen if there is a possibility of developing a model that calculates the optimal number of counters that must be opened by analyzing the arrival rates and service rates of customers for different time periods of different days all throughout the year? How would this model benefit the bank institution?

Most models are centered on the question of finding the ideal level of services that should be provided. Banks must decide how many teller windows to keep open

to serve customers during the day. In most cases, this level of service is an option within the management's control. For example, an extra teller can be borrowed from another department or can be hired and trained quickly if demand warrants it. This may not always be the case, though. For example, a plant may not be able to locate or hire skilled mechanics to repair sophisticated electronic machinery.

When an organization has control, its objective is usually to find a solution between two extremes. On one hand, a bank can retain a large staff and provide many service facilities. This may result in excellent customer service, with seldom more than one or two customers in a queue. Customers are kept happy with the quick response and appreciate the convenience. This, however, can become expensive for the bank.

The other extreme is to have the minimum possible number of teller windows open. This keeps the service cost down but may result in customer dissatisfaction due to poor service.

Most managers recognize the trade-off that must take place between the cost of providing good service and the cost of customer waiting time. They want queues that are short enough so that customers don't become unhappy and either storm out without utilising the service or utilising the service and never return. But they are willing to allow some waiting in line if it is balanced by a significant saving in service costs.

Problem Statement

According to a pilot survey which was conducted at the beginning of this study where 100 questionnaires were disbursed to customers, 63% of the respondents indicated the importance of the queueing issue in the banking sector. About 81% spent up to 30 minutes waiting for service. This study was started in September 1999. Prior to this, there were signs that banks in Malaysia have started to pay attention to the importance of the element of queueing. Maybank started its Priority Banking in 1998 as an alternative to solve its queueing problems. Other efforts include 24-hour banking service as done by Standard Chartered and CitiBank.

Unfortunately, transactions still have to be done during business hours. Customers still have to come in to the bank at the normal banking hours and queue up. Therefore, some of the efforts do not eliminate the queue totally although it does eases the queueing problems to some extent. In view of this, it is evident that the queueing problems still exists despite steps taken to solve it. Therefore, the queueing problems still remain an important issue and need to be studied and solved.

Objectives of the Studies

The aim of proceeding with this study is to:

(1) validate the distribution pattern of the arrival rate and the service time

(2) study the effects of waiting time on the decision on additional counters